

# Time Plan and Control Optimization in Warship Equipment Acquisition Process

Peng Dong<sup>\*1</sup>, Peng Yu<sup>2</sup>, Kewen Wang<sup>3</sup>

Department of Management Engineering, Naval University of Engineering, Wuhan, Hubei, 430033, China

<sup>\*1</sup>rocdong@163.com; <sup>2</sup>yupeng@163.com; <sup>3</sup>kewenwang@163.com

## Abstract

According to the time plan and control optimization management problem of warship equipment acquisition, based on the analysis of its time management characters, we study the time management technologies' application problem of warship equipment acquisition project's time plan and time control phases. In the time plan phase, we put forward a manufacture project example of a new type warship's acquisition. We identify and range its main actions, estimate every action's resources and time, and protract the whole project's time network. In the time control phase, we analyze several time control methods, and study the problem roundly by using supplemental plan method.

## Keywords

*Warship Equipment Acquisition; Time optimization; Time Plan; Time Control*

## Introduction

The complexity of warship equipment makes the acquisition cycle which often is compared commonly long, large and medium-sized ship from the demonstration to build until delivered to the army, generally needing 6-7 years or even 10 years. Therefore, whether as Party A and the military as purchaser, or contract Party B and the production side of the enterprise, will directly affect the warship equipment can force delivery on time and as soon as a fighting force of progress management effect of warship equipment acquisition process quality. Self country's transition goes from a planned economy to a market economy system since the warship equipment acquisition is facing a new environment, and a new variety of issues. Both in the internal system and external environment, there are many problems in practice, so that the emergence of the "behind schedule, lower performance, rising costs" phenomenon is obvious<sup>[1-3]</sup>. In order to minimize the occurrence of "behind schedule" phenomenon, it is necessary to progress management problems of warship equipment acquisition project research. This article starts from the application of the schedule management technology in ship's equipment acquisition activities, in order to provide certain reference schedule to solve the quality problems of warship equipment acquisition at present.

## Warship Equipment Acquisition Project Schedule Management Characteristics

In equipment acquisition project management of ship, the schedule is an important work<sup>[4]</sup>. "Progress" elements of the management in ship's equipment acquisition in detail from the time of each part of the stage, the overall acquisition project total completion time and the project in the planning and control management. Compared with the "quality" and "fees" and other factors, "progress" is the time, which are scarce resources. Periodic schedule of equipment acquisition project between fighting strength forming speed, and change of the schedule may cause irreparable damage, and change, such as the strategic opportunity of new technology breakthrough may cause great influence on the equipment acquisition task. If the schedule is not accurate enough, then the implementation of the project may only have a result -- it is hard to finish on time, and it is impossible to achieve the ultimate goal of the project.

However, the progress of the management of warship equipment acquisition is a very difficult work. The destroyers as an example, need greatly small procedures add up to tens of thousands of items, if all processes use a network diagram to indicate, drawing close to the size of a basketball court. Therefore, warship equipment acquisition schedule management not only is based on the general rules, but also must grasp the following

principles:

1) Phased principle. The current ship construction is the implementation of block construction principle, so the schedule management is in accordance with the idea of segmented, each segment has its own independent schedule management, overallly the whole boat has a total plan.

2) Insist on the principle of predictability. Time schedule, should give full consideration to the weekends, holidays and other holidays; for each process, to consider the latest finish time, in general the largest acquisition cycle on the project full estimate.

The scientific sides on how to develop schedule according to the effective working days, determine the critical path and non critical path and floating time. Such as "network technology", "critical path method" and "program evaluation and review technique" and the project schedule management method and technology.

### Warship Equipment Acquisition Project Schedule Plan

The activities of sorting are one of the important work schedules, activity sequencing is not a good will to develop schedule which brings great difficulty. Activity sequencing is actually determined by the activities of the logical relationship. The logical relations between the activities are usually determined by the following factors.

1) Rules of equipment acquisition project activities. In the acquisition of equipment in the project activity should strictly follow certain procedures. If the argument advanced feasibility, and then on the project; the first complete development work, and then is put into production stage, etc. In these activities, if not according to the sequence of work, things can be done, but may therefore have to pay more prices and take more risks.

2) The scarcity of resources constraints. Great in a work and operating personnel and equipment under the conditions of limited resources, it can only be the work which is divided into several parts, and then another part of work is done in the part of the work completed, this invisible procedure will be in between the parts of a work to produce finished sequence relationship that is logical relationship.

3) The process requirements. In many cases, a result of the work is the prerequisite for another job, this determines another work can be carried out only when the former work is completed. This is the objective law of the existence of things inside, people must follow rather than violate.

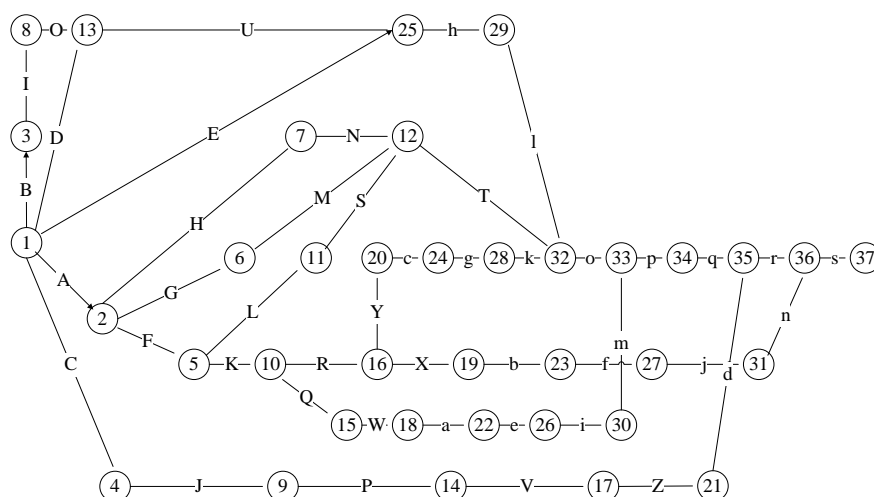


FIG. 1 WARSHIP DEVELOPMENT SCHEDULE NETWORK DIAGRAM

Various kinds of historical data and the experience of experts estimated according to information resource and time to collect, the difficulty of estimating the maximum is the application of new technology, activities, resources and time estimation of this kind of activity can be the reference to foreign similar domestic projects or data reference. In general, new technology and process development are validated, so there is a reference standard. Estimate there sources and time after the main activities in recognition of the project, we can create a schedule. Methods are commonly used in the network diagram, Gantt charts, milestone charts, where there is also the use of

simple graphs. According to the method of network chart drawing network diagram, this type of warship development as shown in FIG. 1, TABLE 1 is the development process as well as the contents of project estimates.

TABLE 1 A TYPE OF WARSHIP DEVELOPMENT PROJECT SCHEDULE

Code	Numbering		Process name or content	Time (week)		
	i	j		optimistic	most likely	pessimistic
A	1	2	The scheme demonstration	8.57 w	8.57 w	8.57 w
B	1	3	Durability test	77.14 w	77.14 w	77.14 w
C	1	4	Total period of module design, construction technology	50 w	51.43 w	53 w
...	...	...	.....	...	...	...
a	18	22	The first general section complete parts manufacturing	33 w	34.29 w	35 w
b	19	23	Construction design	89 w	90 w	91 w
c	20	24	Start, (the first boat) to pump the water first total section	46.5 w	47.14 w	48 w
...	...	...	.....	...	...	...
s	36	37	Navigation test	50 w	51.43 w	53 w

According to the schedule estimation problem, for example, activity sequencing and duration estimation as shown in FIG. 2, we assume that the start time is to 0 and must be completed in thirty-second days before.

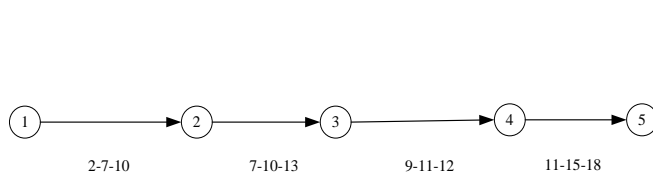


FIG. 2 SCHEMATIC DIAGRAM OF THE ESTIMATED SCHEDULE

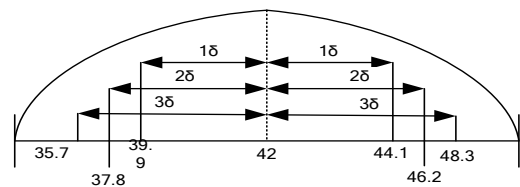


FIG. 3 NORMAL PROBABILITY DISTRIBUTION

First activity,  $t=(2+4*7+10)/6=7$ ; second activities,  $t=(7+4*10+13)/6=10$ ; third activities,  $t=(9+4*11+12)/6=10$ ; fourth activities,  $t=(11+4*15+18)/6=15$ . These four estimated duration of the expected distribution of total value added, can get an average value, namely the expected duration of the whole project. See TABLE 2.

TABLE 2 THE PROJECT ACTIVITY DURATION ESTIMATION SUMMARY TABLE(UNIT: DAY)

Activity	Optimistic time	Most likely time	Pessimistic time	Expected duration
First	2	7	10	7
Second	7	10	13	10
Third	9	11	12	10
Fourth	11	15	18	15
Whole	29	43	53	42

Optimistic time 29 days, most likely time 43 days and pessimistic time 53 days calculated activities of the whole, and according to the three activities expected value  $(7+10+10+15)$  and the result is the same, which indicates that the whole activities, in which more than expected duration and less than the expected duration of the time is offset each other. Therefore, estimating activity overall project time distribution is equal to three activities consume time average or expected value. The 42 day is the normal probability distribution of expectations, probability completed in forty-second days before the 50%, and completed in forty-second days after the probability is 50%.

1) Variance of four activities: First activity,  $\delta^2=[(10-2)/6]^2=1.778$ ; second activities,  $\delta^2=[(13-7)/6]^2=1$ ; third activities,  $\delta^2=[(12-9)/6]^2=0.25$ ; fourth activities:  $\delta^2=[(18-11)/6]^2=1.36$ . Because the total distribution is a normal distribution, so its variance is combined variance four activities, 4.388.

2) Total distribution of the standard deviation:  $\delta=2.1$ .

Fig. 3 shows the total probability curve and diagram of standard deviation. From this normal curve, it can be seen in the range between the 39.9 and 44.1 day which contains 68% of the total area; between 37.8 and 46.2 days which contained 95% of the total area; between 35.7 days and 48.3 days which contains 99% of the total area.

- (1) the probability of completing the project was 99% between 35.7 to 48.3 days;
- (2) the probability of completing the project was 95% between 37.8 days and 46.2 days;
- (3) the probability of completing the project was 68% between 39.9 days and 44.1 days.

### Warship Equipment Acquisition Project Schedule Control

Schedule management focuses on the control, so that the project can complete the purchase task<sup>[5]</sup> within the prescribed time limit. There are many kinds of methods of project schedule control, the use of these methods can control the impact of various factors in the progress of the project. In the analysis of progress deviation, generally the following methods can be used to correct the deviation of the:

#### *Project Schedule Change Method of Control System*

The project schedule change control system includes change of application program, change of approval procedures and powers arrangement, change of tracking control procedure and method.

#### *Measure Method of the Implementation of the Project Schedule*

The main contents of method include: the implementation of data collected periodically by the progress of the project, the actual situation and plan comparison, analysis which gives the implementation of the existing project schedule deviation and which are given by correcting measures etc.

#### *Additional Plan Method*

Additional planning method involves four basic steps: analysis of the project implementation schedule and to find out the existing problems, to determine what specific corrective measures should be taken, to develop additional plans, and the implementation of the new plan. This method requires the analysis focuses on two kinds of activities: one is the project activity needed to be carried out recently; the other is the project activity needed for a long time.

Corrective measures can be taken: do not increase the staff but work overtime, or do not work overtime but increase the staff. If we choose the former, the existing staffs, calculated according to two hours of overtime every day, need to work overtime continuously 12 working days to finish on time, and those calculated according to three hours of overtime every day, need to work overtime continuously 8 working days; if the latter, an increase of 3 on the existing basis, only needs 7 working days to catch up with the original schedule plan. The two schemes have their own advantages and disadvantages, then according to the actual situation when to choose the best scheme.

### Conclusion

"Progress" is the warship equipment acquisition project "big boss", in the "quality", "progress" and "costs" three elements, schedule management in the whole project control target and in an important position, bringing other work coordination control system, is the whole warship equipment acquisition item time guarantee. Therefore, "progress" is the essential factors should be preferred and fully equipped in the acquisition management plan. Schedule management problem research of warship equipment acquisition projects takes the initiative to try to use all kinds of advanced management tools and methods to make progress, naval warship equipment acquisition activities schedule performance and supervision work more scientific and reasonable, so as to improve execution efficiency of the ship project equipment acquisition under the new system, achieving better military beneficial results.

### REFERENCES

- [1] Ji Gang, Chai Zhen hai. A few points about the equipment purchasing system reform thinking [J]. defense technology base, 2005 (4):19-21.

- [2] Zhang Yan about the equipment purchase system reform thinking of [J]. based defense technology, 2005 (4):7-12.
- [3] Zhang Yunan, Zhao Wenyan. The equipment purchasing system reform to explore the [J]. Chinese national defense economy, 2002 (2):17-25.
- [4] Liu Yuming. Modern military equipment acquisition and project management standards and equipment performance analysis, optimization, evaluation practices book [M]. Beijing:China culture of science and Technology Press, 2006.
- [5] Zhu Yingfu. Ship design of the new technology [M]. Harbin:Harbin Engineering University press, 2004.